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ALBERT EINSTEIN AND THE ATOMIC AGE: A QUESTION OF RESPONSIBILITY

- 1879 Born
- 1905 First basic papers published
- 1916 Published fundamental paper on the
general theory of relativity
- 1921 Won Nobel Prize in physics
- 1933 Fled from Germany to the United
States
- 1939 Manhattan Project to create the
atomic bomb begun
- 1945 Atomic bombs dropped on Hiroshima
and Nagasaki
- 1955 Died

By the early 1930s, Albert Einstein was the most famous scientist in the world. Indeed, he had become a kind of symbol for the abstruseness of modern science itself, an expert in a branch of theoretical physics so remote and lofty that—at least according to the popular press—only a dozen other people could even understand his theories, much less explain them.

Long before this time, Einstein had established the fundamental direction of his work. As early as 1905, at the age of twenty-six, he had published very important papers, among them his theory of relativity, his work on statistical mechanics, and the quantum theory of radiation. When these first papers were published, Einstein was working as a patent clerk in Berne because he could not find an academic position, but by 1914 he held a professorship at the University of Berlin and was director of the Institute of Physics in the Kaiser Wilhelm Society for the Development of Sciences and a member of the Royal Prussian Academy of Sciences. In 1916 he published the fundamental paper on the general theory of relativity that established his worldwide fame, and in 1921 he received the Nobel Prize for Physics.

Although Einstein's main interest through the late 1920s was in the development of what came to be called his general field theory, other developments far removed from the abstractions of science had begun to crowd in upon his world. Hitler was on the rise in Germany, and Einstein was a Jew. In 1933 Einstein resigned his academic appointments, severed the associations of a lifetime, and joined the thousands of Jews, humble and famous, who had already begun to flee Hitler's Germany. An honored position was created for him at the Institute for Advanced Study at Princeton University, and there he remained for the rest of his life.

Einstein maintained contact with other brilliant refugee physicists who had fled the tyrannies of Europe, among them his old friend Max Born in England, the Hungarian Leo Szilard in the United States, and dozens of other scholars. These men, through their ties with what remained of the old international community of physicists, began to hear troubling rumors in the mid-1930s of experimental work being done in Europe in the field of atomic energy. Then in 1939 Niels Bohr brought word that Hahn and Strassman of the Kaiser Wilhelm Society in Berlin had actually produced nuclear fission. An atomic bomb was now a practical possibility. The work that Bohr reported and the work that would subsequently be done in Germany, England, and the United States was based, in the last analysis, upon Einstein's theories.

Twenty years before, Einstein had argued in his special theory of relativity that, as an object approached the speed of light, its acceleration would tend to produce not only increased speed but increased mass. He explained the process in the elegantly simple equation $E = mc^2$, in which the potential energy (E) of an object is equal to its mass (m) multiplied by the square of the speed of light (c^2). The enormous product of energy that would result from even the most infinitesimal transformation of mass—with the speed of light computed at 186,000 miles per second—was quite beyond anything but mathematical comprehension and even theoretically possible in terrestrial physics only at the atomic level. Now, working with unstable, heavy elements and apparently quite by accident, German scientists had produced a nuclear chain reaction, the instantaneous transformation of one element into another with exactly the incredible release of energy that Einstein's equation had described. As Leo Szilard would later write, "The dream of the alchemists came true. . . . But while the first successful alchemist was undoubtedly God, I sometimes wonder if the second successful alchemist may not have been the Devil himself."¹

¹"Creative Intelligence and Society," in *Collected Works of Leo Szilard*. . . , ed. B. T. Feld and G. W. Szilard (Cambridge, Mass.: M.I.T. Press, 1972), I, 189.

If German scientists had discovered the secret of atomic fission, it would probably not be long before the German government would have an atomic bomb. This prospect brought Leo Szilard and Eugene Wigner to Einstein. As a result of their discussion, Einstein immediately agreed to take action and eventually signed the now famous letter to President Roosevelt urging government support of research on nuclear chain reactions. Now, with the alarming news from Germany and the push from Einstein, serious work on the Manhattan Project began, and with it the chain of events leading to the explosions over Hiroshima and Nagasaki in August 1945.

The Complaint of Peace

ALBERT EINSTEIN

Technology is older than science, but through the centuries the two have always been linked together, technology adapting the theoretical findings of science to the practical uses of society. Sad to say, these uses, more often than not, have been military. With "the bomb," society at last had the ultimate weapon, the doomsday machine capable of destroying not only one's enemies but all humanity.

With the bomb there also came the difficult question of the scientists' moral responsibility for the application of their theoretical and experimental work. One of the most troubled by this question was Albert Einstein. In December 1945, within months of the explosions over Japan, Einstein addressed the Nobel Anniversary Dinner in New York, speaking of the parallel between Alfred Nobel and his desire to atone for the invention of "an explosive more powerful than any then known" and the physicists "who participated in producing the most formidable weapon of all time" and who "are harassed by a similar feeling of responsibility, not to say guilt." But, he continued, their choice was as clear as their anguish was real. "We helped create this new weapon in order to prevent the enemies of mankind from achieving it first. . . . The war is won, but the peace is not."²

The persistent theme of all Einstein's public statements and the principal concern of the last decade of his life was the creation of a supranational organization to make sure that the bomb would never again be used. Some of Einstein's friends were exasperated with him for his continued refusal to advocate the surrender of the bomb to the United Nations, then in its confident infancy. But Einstein perceived the essential weakness of that organization, later to be so tragically demonstrated: it was not capable of keeping the peace. But his own proposal—the establishment of a world government—was even more unrealistic.

Einstein stated his views in an interview-article with Raymond Swing that originally appeared in the Atlantic Monthly in November 1945. A slightly revised version of this article, from Einstein on Peace, is reprinted below in its entirety. Einstein's statements tended to be brief and simple. But in this piece, it is not his arguments that are striking; rather, it is the tension between his belief that pure science is essentially unmanageable and his profound sense of the scientist's moral responsibility in the realm of human affairs.

The release of atomic energy has not created a new problem. It has merely made more urgent the necessity of solving an existing one. One could say that it has affected us quantitatively, not qualitatively. As long as there are sovereign nations possessing great power, war is

inevitable. This does not mean that one can know when war will come but only that one is sure that it will come. This was true even before the atomic bomb was made. What has changed is the destructiveness of war.

I do not believe that the secret of the bomb should be given to the United Nations Organization. I do not believe it should be given to the Soviet Union. Either course would be analogous to a man with capital who, wishing another individual to collaborate with him on an enterprise, starts by giving him half his money. The other man might choose to start a rival enterprise, when what is wanted is his co-operation. The secret of the bomb should be committed to a world government, and the United States should immediately announce its readiness to do so. Such a world government should be established by the United States, the Soviet Union, and Great Britain, the only three powers which possess great military strength. The three of them should commit to this world government all of their military resources. The fact that there are only three nations with great military power should make it easier, rather than harder, to establish a world government.

Since the United States and Great Britain have the secret of the atomic bomb and the Soviet Union does not, they should invite the Soviet Union to prepare and present the first draft of a Constitution for the proposed world government. This would help dispel the distrust of the Russians, which they feel because they know the bomb is being kept a secret chiefly to prevent their having it. Obviously, the first draft would not be the final one, but the Russians should be made to feel that the world government will guarantee their security.

It would be wise if this Constitution were to be negotiated by one American, one Briton, and one Russian. They would, of course, need advisers, but these advisers should serve only when asked. I believe three men can succeed in preparing a workable Constitution acceptable to all the powers. Were six or seven men, or more, to attempt to do so, they would probably fail. After the three great powers have drafted a Constitution and adopted it, the smaller nations should be invited to join the world government. They should also be free not to join and, though they should feel perfectly secure outside the world government, I am sure they will eventually wish to join. Naturally, they should be entitled to propose changes in the Constitution as drafted by the Big Three. But the Big Three should go ahead and organize the world government, whether or not the smaller nations decide to join.

Such a world government should have jurisdiction over all military matters, and it need have only one other power. That is the power to interfere in countries where a minority is oppressing the majority and, therefore, is creating the kind of instability that leads to war. For example, conditions such as exist today in Argentina and Spain

²Einstein on Peace, ed. Otto Nathan and Heinz Norden (New York: Schocken Books, 1968), p. 355.

should be dealt with. There must be an end to the concept of non-intervention, for to abandon non-intervention in certain circumstances is part of keeping the peace.

The establishment of a world government should not be delayed until similar conditions of freedom exist in each of the three great powers. While it is true that in the Soviet Union the minority rules, I do not believe that the internal conditions in that country constitute a threat to world peace. One must bear in mind that the people in Russia had not had a long tradition of political education; changes to improve conditions in Russia had to be effected by a minority for the reason that there was no majority capable of doing so. If I had been born a Russian, I believe I could have adjusted myself to this situation.

It should not be necessary, in establishing a world government with a monopoly of authority over military affairs, to change the internal structure of the three great powers. It would be for the three individuals who draft the Constitution to devise ways for collaboration despite the different structures of their countries.

Do I fear the tyranny of a world government? Of course I do. But I fear still more the coming of another war. Any government is certain to be evil to some extent. But a world government is preferable to the far greater evil of wars, particularly when viewed in the context of the intensified destructiveness of war. If such a world government is not established by a process of agreement among nations, I believe it will come anyway, and in a much more dangerous form; for war or wars can only result in one power being supreme and dominating the rest of the world by its overwhelming military supremacy.

Now that we have the atomic secret, we must not lose it, and that is what we would risk doing if we gave it to the United Nations Organization or to the Soviet Union. But, as soon as possible, we must make it clear that we are not keeping the bomb a secret for the sake of maintaining our power but in the hope of establishing peace through world government, and that we will do our utmost to bring this world government into being.

I appreciate that there are persons who approve of world government as the ultimate objective but favor a gradual approach to its establishment. The trouble with taking little steps, one at a time, in the hope of eventually reaching the ultimate goal, is that while such steps are being taken, we continue to keep the bomb without convincing those who do not have the bomb of our ultimate intentions. That of itself creates fear and suspicion, with the consequence that the relations between rival countries deteriorate to a dangerous extent. That is why people who advocate taking a step at a time may think they are approaching world peace, but they actually are contributing by their slow pace to the possibility of war. We have no time to waste in this way. If war is to be averted, it must be done quickly.

Further, we shall not have the secret of the bomb for very long. I know it is being argued that no other country has money enough to spend on the development of the atomic bomb and that, therefore, we are assured of the secret for a long time. But it is a common mistake in this country to measure things by the amount of money they cost. Other countries which have the raw materials and manpower and wish to apply them to the work of developing atomic power can do so; men and materials and the decision to use them, and not money, are all that is needed.

I do not consider myself the father of the release of atomic energy. My part in it was quite indirect. I did not, in fact, foresee that it would be released in my time. I only believed that it was theoretically possible. It became practical through the accidental discovery of chain reaction, and this was not something I could have predicted. It was discovered by Hahn in Berlin, and he himself at first misinterpreted what he discovered. It was Lise Meitner who provided the correct interpretation and escaped from Germany to place the information in the hands of Niels Bohr.³

In my opinion, a great era of atomic science cannot be assured by organizing science in the way corporations are organized. One can organize the application of a discovery already made, but one cannot organize the discovery itself. Only a free individual can make a discovery. However, there can be a kind of organization wherein the scientist is assured freedom and proper conditions of work. Professors of science in American universities, for instance, should be relieved of some of their teaching so as to have more time for research. Can you imagine an organization of scientists making the discoveries of Charles Darwin?

I do not believe that the vast private corporations of the United States are suitable to the needs of the times. If a visitor should come to this country from another planet, would he not find it strange that, in this country, private corporations are permitted to wield so much power without having to assume commensurate responsibility? I say this to stress my conviction that the American government must retain control of atomic energy, not because socialism is necessarily desirable but because atomic energy was developed by the government; it would be unthinkable to turn over this property of the people to any individual or group of individuals. As for socialism, unless it is international to the extent of producing a world government which controls all military power, it might lead to wars even more easily than capitalism because it represents an even greater concentration of power.

³Einstein is in error on a minor point. Lise Meitner did not "escape from Germany to place the information [about atomic fission] in the hands of Niels Bohr." She was already in Sweden at the time.

To give any estimate as to when atomic energy might be applied for peaceful, constructive purposes is impossible. All that we know now is how to use a fairly large quantity of uranium. The use of small quantities, sufficient, say, to operate a car or an airplane, is thus far impossible, and one cannot predict when it will be accomplished. No doubt, it will be achieved, but no one can say when. Nor can one predict when materials more common than uranium can be used to supply atomic energy. Presumably, such materials would be among the heavier elements of high atomic weight and would be relatively scarce due to their lesser stability. Most of these materials may already have disappeared through radioactive disintegration. So, though the release of atomic energy can be, and no doubt will be, a great boon to mankind, this may not come about for some time.

I myself do not have the gift of explanation which would be needed to persuade large numbers of people of the urgency of the problems that now face the human race. Hence, I should like to commend someone who has this gift of explanation: Emery Reves, whose book *The Anatomy of Peace* is intelligent, clear, brief, and, if I may use the absurd term, dynamic on the topic of war and need for world government.

Since I do not foresee that atomic energy will prove to be a boon within the near future, I have to say that, for the present, it is a menace. Perhaps it is well that it should be. It may intimidate the human race into bringing order to its international affairs, which, without the pressure of fear, undoubtedly would not happen.

Einstein and the Bomb

OTTO NATHAN AND HEINZ NORDEN

Einstein clearly did not consider himself to be the father of the bomb. Indeed, as he stated in the preceding article, he felt his role to be quite indirect. How Einstein came to be involved in the American effort to construct the atomic bomb is a fascinating story, especially in light of the fact that as late as 1939 he did not seem to be very optimistic about practical applications of nuclear fission. But international events finally prompted Einstein to advise President Roosevelt and the American government to undertake the work that became the Manhattan Project and ultimately produced the bomb. The circumstances leading to Einstein's action are described by Otto Nathan, one of Einstein's confidants and the executor of his will, and Heinz Norden in Einstein on Peace, from which the following selection is excerpted.

It was only . . . in the early summer of 1939 that Einstein, through Szilard, became involved in the efforts to experiment with the construction of atomic bombs. It would appear that, several years before, Einstein had been very doubtful about the possibility of splitting the atom. At the winter session of the American Association for the Advancement of Science in Pittsburgh in January 1935, reporters asked Einstein whether he thought that scientists would ever be able to transmute matter into energy for practical purposes. In the subsequent newspaper account, which should be considered with caution, Einstein is reported to have replied that he felt almost certain it would not be possible, and to have referred to the vast amount of energy required to release energy from a molecule. "It is," he is reported to have added, "something like shooting birds in the dark in a country where there are only a few birds."

It is possible that Einstein may have learned early in 1939 about the Hahn-Strassmann-Meitner-Frisch work as well as about subsequent publications concerning these developments. It does not appear, however, that he was very optimistic regarding the possibility of a practical application of the new scientific discoveries at an early date. In a statement made in reply to a question submitted to him on the occasion of his sixtieth birthday, March 14, 1939, and published in *The New York Times*, Einstein made the following remarks:

The results gained thus far concerning the splitting of the atom do not justify the assumption that the atomic energy released in the process could be economically utilized. Yet, there can hardly be a physicist with so little intellectual curiosity that his interest in this important subject could become impaired because of the unfavorable conclusion to be drawn from past experimentation.

Szilard's first contact with Einstein in the matter of nuclear fission took place several months later. When he first considered consulting with Einstein about the new scientific discoveries and their implications, he did not contemplate any approach to the United States Government. Szilard recalls that he and Wigner had by this time become very perturbed by the thought that Germany might obtain large quantities of uranium from the Belgian Congo, the chief source of the material. Germany might thus be greatly helped in her research on atomic energy and ultimately in the production of atomic bombs. Szilard and Wigner felt that the Belgian Government should be advised of these eventualities in order that uranium exports to Germany might be halted if Belgium so desired. Szilard knew that Einstein had for years been on friendly terms with Queen Elizabeth of Belgium. When he and Wigner decided to visit Einstein at Nassau Point, Peconic, Long Island, where Einstein was spending the summer, it was, as Szilard has reported, their intention to suggest to Einstein that he communicate with Queen Elizabeth. It is one of the

dramatic aspects of the whole atomic development that this visit, with a relatively modest and probably inconsequential purpose, led to events of completely different and, eventually, momentous import. The visit took place around July 15, 1939.

Szilard recalls that Einstein, when told about the possibility of producing a chain reaction, exclaimed, "*Daran habe ich gar nicht gedacht!*" (That never occurred to me!). Szilard reports that Einstein immediately recognized the implication of Germany's access to uranium in the Congo and declared he would be prepared to assist in informing the Belgian Government accordingly. Several approaches to the problem were discussed by the three scientists. Wigner apparently emphasized not only the desirability of advising the Belgian Government through the Queen or the Belgian Ambassador in Washington of the dangers involved in uranium exports to Germany but also the need for large imports of uranium into the United States. Whether recommendations were made as to how to secure such imports or who might be approached on the matter is not known. Einstein is reported to have favored a suggestion, apparently also offered by Wigner, to submit to the State Department a draft of a projected letter to the Queen of Belgium. The letter would be mailed to the Queen only if no objection were raised by the State Department. There is no information available as to whether, at this original meeting, Einstein, Szilard, and Wigner considered advising the American Government of the implications of the new scientific discoveries with a view to engaging its interest in promoting or subsidizing further research in the atomic field.

Even before his visit to Einstein, Szilard had discussed the entire problem with a New York friend in the financial world; he had felt that the financial resources of the physics department of Columbia University would not suffice for the additional research contemplated by Fermi and himself and that outside funds would therefore be necessary. Upon Szilard's return to New York from his visit to Einstein, the finance expert informed him that he had consulted with Dr. Alexander Sachs, a well-known economist connected with the New York banking house of Lehman Brothers and sometimes one of President Roosevelt's unofficial advisers. When it was suggested to Szilard that he communicate with Dr. Sachs, he did so, apparently without delay. It was undoubtedly Sachs who recognized the magnitude and significance of the problem and realized that, to obtain results, the matter should be brought to the attention of the White House. He, therefore, suggested to Szilard that Einstein's letter be addressed to President Roosevelt rather than to the Belgian Queen or the Belgian Ambassador. Sachs offered to see to it that the letter would reach the President personally. Writing to Einstein on July 19, 1939, Szilard stated that, although he had seen Sachs only once in his life and had

not been able to form an opinion of him, he nonetheless recommended accepting the course of action outlined by him. Szilard added that this recommendation was also supported by Professor Edward Teller, then guest professor at Columbia University, with whom he had consulted. Szilard further suggested that Einstein's projected letter be entrusted to Sachs since he believed that Sachs was in a position to do as he had promised. Szilard enclosed a draft of the letter. Since Sachs was to play an important role during the ensuing months, and since Einstein's letter to Roosevelt was to release a "chain reaction" which possibly no move by any other individual could have effected at that time, Szilard's casually arranged meeting about an all-important matter with a person completely unknown to him, his subsequent confidence in that person on the basis of a single meeting, and Sachs's perception of Roosevelt's capacity for bold decisions are startling incidents in the drama that was to unfold.

While it is not possible to reconstruct all the developments during the two weeks following Szilard's meeting with Sachs, it is known that, during this period, Szilard once again called on Einstein at his Long Island summer home. Since Wigner was out of town, Szilard was accompanied on his second visit by Edward Teller. At this meeting with Szilard and Teller, if not before by phone or mail, Einstein accepted Sachs's suggestion to bring the matter to the attention of the President and to have a letter to Roosevelt transmitted through Sachs. Einstein dictated to Teller the draft of a letter in German which is preserved in his files. This draft contains some of the main points of the history-making communication to Roosevelt that Einstein was eventually to sign. . . .

Einstein's draft is an indication of how, in possibly less than a week, the initial modest proposition to write a letter to the Belgian Queen had developed into a meaningful and highly suggestive approach to the President of the United States. Whether Einstein's dictated draft was inspired by the draft which Szilard had prepared after his meeting with Sachs and had mailed to Einstein before his second visit cannot be ascertained. On August 2, 1939, Szilard wrote to Einstein that, in his discussions with Sachs about additional recommendations, K. T. Compton, Bernard Baruch, and Charles Lindbergh had been suggested for the position of liaison man between the government and the atomic scientists, the position recommended in Einstein's draft and also in his final letter to Roosevelt. Szilard added that Lindbergh was the "favorite" at the time of writing.

On the basis of Einstein's German draft, Szilard prepared, after a further meeting with Sachs, two English versions of a letter to the President, which he forwarded to Einstein in his letter of August 2, 1939. Einstein favored the shorter of the two Szilard drafts. The letter actually sent to Roosevelt and dated August 2, 1939, reads as follows:

Albert Einstein
Old Grove Road
Nassau Point
Peconic, Long Island
August 2, 1939

F. D. Roosevelt
President of the United States
White House
Washington, D.C.

Sir:

Some recent work by E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of the situation seem to call for watchfulness and, if necessary, quick action on the part of the Administration. I believe, therefore, that it is my duty to bring to your attention the following facts and recommendations.

In the course of the last four months it has been made probable—through the work of Joliot in France as well as Fermi and Szilard in America—that it may become possible to set up nuclear chain reactions in a large mass of uranium, by which vast amounts of power and large quantities of new radium-like elements would be generated. Now it appears almost certain that this could be achieved in the immediate future.

This new phenomenon would also lead to the construction of bombs, and it is conceivable—though much less certain—that extremely powerful bombs of a new type may thus be constructed. A single bomb of this type, carried by boat or exploded in a port, might very well destroy the whole port together with some of the surrounding territory. However, such bombs might very well prove to be too heavy for transportation by air.

The United States has only very poor ores of uranium in moderate quantities. There is some good ore in Canada and the former Czechoslovakia, while the most important source of uranium is the Belgian Congo.

In view of this situation you may think it desirable to have some permanent contact maintained between the Administration and the group of physicists working on chain reactions in America. One possible way of achieving this might be for you to entrust with this task a person who has your confidence and who could perhaps serve in an unofficial capacity. His task might comprise the following:

a) To approach Government Departments, keep them informed of the further developments, and put forward recommendations for Government action, giving particular attention to the problem of securing a supply of uranium ore for the United States.

b) To speed up the experimental work which is at present being carried on within the limits of the budgets of University laboratories, by providing funds, if such funds be required, through his contacts with private persons who are willing to make contributions for this cause, and perhaps also by obtaining the cooperation of industrial laboratories which have the necessary equipment.

I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such early action might perhaps be understood on the ground that the son of the German Under-Secretary of State, von Weizsäcker, is attached to the Kaiser Wilhelm Institute in Berlin, where some of the American work on uranium is now being repeated.

Yours very truly,
A. Einstein

This letter, addressed by the then greatest living scientist to one of the most important political leaders of the world, bearing on dramatically important scientific and military developments and suggesting crucial moves by the American Government, was actually not submitted to President Roosevelt for over two months, during which period the Germans might have made much progress in the search for a nuclear chain reaction. The available documents in Einstein's files and all other sources of information fail to provide an adequate explanation for the delay in transmitting Einstein's communication. In a letter of September 27, 1939, Szilard conveyed to Einstein his impression that the letter "had already been in Washington for some time." But in another letter, dated October 3, 1939, Szilard reported that he and Wigner had called on Sachs, and Sachs admitted still having Einstein's letter in his possession; Sachs explained that he had gained the impression from several telephone conversations with Roosevelt's secretary that it was advisable to see the President at a later time since he was overburdened with work. In his testimony of November 27, 1945, before the Special Committee on Atomic Energy of the United States Senate, Sachs stated that he had not wanted to accept an appointment with the President as long as the President was involved in revising the existing neutrality legislation. However, the neutrality legislation did not become an acute issue until the war broke out in Europe on September 1, 1939, which was more than four weeks after Einstein had signed the letter.

In his letter to Einstein of October 3, 1939, Szilard remarked that he and Wigner had begun to wonder whether it might not become necessary to entrust another person with the mission Dr. Sachs had volunteered to perform. But Sachs did finally see President Roosevelt on October 11, 1939, and submitted to the President Einstein's letter, a more technical memorandum by Szilard, as well as considerable

background material. The Szilard memorandum stated that, if fast neutrons could be used, "it would be easy to construct extremely dangerous bombs . . . with a destructive power far beyond all military conceptions." Sachs also submitted to the President a written statement of his own in which he summarized the main problems involved and listed the steps which he thought should be taken by the United States in the matter of further exploring the problem of nuclear fission.

President Roosevelt acted at once. He appointed an "Advisory Committee on Uranium," which was to report to him as soon as possible; a few days later, he addressed the following letter to Einstein:

The White House
Washington

October 19, 1939

My dear Professor,

I want to thank you for your recent letter and the most interesting and important enclosure.

I found this data of such import that I have convened a board consisting of the head of the Bureau of Standards and a chosen representative of the Army and Navy to thoroughly investigate the possibilities of your suggestion regarding the element of uranium.

I am glad to say that Dr. Sachs will co-operate and work with this committee and I feel this is the most practical and effective method of dealing with the subject.

Very sincerely yours,
Franklin D. Roosevelt

. . . The further history of the many stages in the development of the atomic bomb is recorded in other publications and need not be repeated. What is of interest here are the few instances when Einstein again intervened.

After the first meeting of the Advisory Committee, other scientists were invited to participate in subsequent consultations. Sachs continued to play a very important role as the representative of the President and, as he himself frequently emphasized, as the individual who maintained contact with Einstein: he consulted with Einstein and presented Einstein's opinions and suggestions to the President or the committee orally or in writing, as circumstances would dictate. . . .

Although the Advisory Committee continued to operate, Szilard and Sachs were perturbed at its relatively slow progress and, in Febru-

ary 1940, they decided once again to secure Einstein's intervention. It took the form of another letter from Einstein, dated March 7, 1940.

In this letter, Einstein reviewed the rapid development of atomic research—Szilard's and Fermi's continuing work, for example, and the likelihood that similar work was going forward in Europe, especially in Germany.

On March 15, 1940, Sachs brought Einstein's second letter to the attention of the President, who, on April 5, 1940, proposed an enlarged meeting of the Advisory Committee on Uranium which would include Einstein and others whom Einstein might suggest. Briggs, the chairman of the committee, invited Einstein to participate in such a meeting. Since Einstein was unable to accept the invitation, he addressed, on April 25, 1940, the following letter to Briggs:

I thank you for your recent communication concerning a meeting of the Special Advisory Committee appointed by President Roosevelt.

As, to my regret, I shall not be able to attend this meeting, I have discussed with Dr. Wigner and Dr. Sachs particularly the questions arising out of the work of Dr. Fermi and Dr. Szilard. I am convinced as to the wisdom and the urgency of creating the conditions under which that and related work can be carried out with greater speed and on a larger scale than hitherto. I was interested in a suggestion made by Dr. Sachs that the Special Advisory Committee submit names of persons to serve as a board of trustees for a nonprofit organization which, with the approval of the government committee, should secure from governmental or private sources, or both, the necessary funds for carrying out the work. It seems to me that such an organization would provide a framework which could give Dr. Fermi and Dr. Szilard and co-workers the necessary scope. The preparation of the large-scale experiment and the exploration of the various possibilities with regard to practical applications is a task of considerable complexity, and I think that given such a framework and the necessary funds, it could be carried out much faster than through a loose co-operation of university laboratories and government departments.

As far as can be established, Einstein had no further connection either with the work that preceded the atomic bomb project or with the project itself. The Advisory Committee did not continue much longer as such. When, in June 1940, Roosevelt created the National Defense Research Committee, which was to develop into a very significant organization with regard to America's military preparations, he asked that the Advisory Committee be reorganized, again under the chairmanship of Dr. Briggs, as a subcommittee of the newly created

National Defense Research Committee. The President specifically assigned to the new committee the responsibility for research on nuclear problems. "This meant," Professor Karl T. Compton, a member of the new committee, remarked, "reviewing and acting upon the recommendations of Dr. Briggs's committee."

Viewed in historical perspective, it would appear that the decision to use Einstein's unique authority in the attempt to obtain the government's direct participation and financial assistance in atomic research may well have been decisive, since his intervention succeeded in securing the attention of President Roosevelt. The Advisory Committee on Uranium was organized by the President as an immediate result of Einstein's intervention and was the germinal body from which the whole huge atomic effort developed. Whether, without Einstein's intervention, similar developments would have taken place around the same period, and whether the atomic bomb would still have been produced around the time it was produced—that is, before the end of the war—are legitimate questions. . . .

. . . We shall never know with any degree of certainty what would have happened if Szilard had not called on Einstein in July 1939, or if Einstein, in turn, had not been immediately willing to lend his authority to supporting a request to the President of the United States that was partly based on scientific assumptions and speculations.

A New Vision out of the Ashes

BERNARD T. FELD

In this chapter, we have already considered Einstein's own proposal for a world government as the only alternative he saw to nuclear war. And we considered the circumstances leading to Einstein's involvement in the American atom bomb project. Despite Einstein's statement that his role in that project was indirect and passive and his assertion that he did not consider himself "the father of the release of atomic energy," his last years were haunted by the prospect of nuclear war that the "release of atomic energy" had made possible. Those last years were also haunted by a sense of his own culpability—notwithstanding his protests to the contrary. The activities of Einstein in the years following World War II were devoted to his passionate advocacy of peace, a cause he had long promoted but which now became an obsession. These activities are sympathetically described by the MIT physicist and peace activist Bernard T. Feld in the article "Einstein and the Politics of Nuclear Weapons," published as one of the symposium papers in The Centennial Symposium in Jerusalem, one of several such celebrations in 1979 of the centenary of Einstein's birth.

If relativity captured the public imagination in the period between the wars, the atomic bomb, which ended World War II, propelled Einstein even more directly into the limelight, but under circumstances that caused him acute moral, as well as personal, embarrassment. To the popular mind, Einstein was, and to a large extent remains, the "father of the atomic bomb." Is there any person so ignorant that he or she does not recognize his famous discovery of the equivalence between mass and energy, $E = mc^2$, which provides the theoretical basis for the release of nuclear energy? Add to this Einstein's audacious intervention with President Franklin D. Roosevelt, to convince him of the military potential of the discovery of nuclear fission, and you have the two ingredients of that aspect of the Einstein legend that he worked most diligently and unsuccessfully to debunk.

Einstein's role in the successful American effort during World War II to develop a nuclear bomb was indeed peripheral. On this score, he tried hard to put the record straight. Thus, in response to a request from the editor of a Japanese journal demanding to know why Einstein, "as a great scientist who played an important role in producing the atomic bomb, . . . co-operate[d] in [its] production . . . although you were well aware of its tremendous destructive power?" he protested:

My participation in the production of the atomic bomb consisted of one single act: I signed a letter to President Roosevelt, in which I emphasized the necessity of conducting a large-scale experimentation with regard to the feasibility of producing an atom bomb.

I was well aware of the dreadful danger which would threaten mankind were the experiments to prove successful. Yet I felt impelled to take the step because it seemed probable that the Germans might be working on the same problem with every prospect of success. I saw no alternative but to act as I did, *although I have always been a convinced pacifist.*

Yet the myth persisted that through his earlier discovery of the fundamental mass-energy relationship, Einstein somehow bore responsibility for the final outcome. With great patience, he explained:

Now you seem to believe that I, poor fellow that I am, by discovering and publishing the relationship between mass and energy, made an important contribution to the lamentable situation in which we find ourselves today. You suggest that I should then, in 1905, have foreseen the possible development of atomic bombs. But this was quite impossible since the accomplishment of a "chain reaction" was dependent on the existence of empirical data that could hardly have been anticipated in 1905. But even if such knowledge had been available, it would have been ridiculous to attempt to conceal the particular conclusion resulting from the Special Theory of Relativity. Once the theory existed, the

conclusion also existed and could not have remained concealed for any length of time. As for the theory itself, it owes its existence to the efforts to discover the properties of the "luminiferous ether"! There was never even the slightest indication of any potential technological application.

Even now, some forty years later, the importance of Einstein's role in the American development of nuclear weapons before the end of the war against Japan remains a source of legitimate controversy. Some feel it was seminal, that without his intervention the atomic bomb project would never have received the government attention and support that was indispensable to its success. Others believe that the physics was so compelling that once the early (and very inexpensive) demonstrations of the potentiality had taken place—and they would probably have happened even without government support—not even the most obtuse bureaucracy could have resisted the inevitable pressures of the cream of the American physics community. . . .

In any event, Einstein learned of the success of the Manhattan Project as did the rest of the world—by the public announcement on 8 August 1945 that a single bomb using the fission of an isotope of uranium had destroyed the Japanese city of Hiroshima. Einstein is alleged to have responded to this news with the time-honored lament, "Oy Weh!" (woe upon us).

There can be no question as to where Einstein would have stood with respect to the dropping of the bombs on Japan. In a letter of 19 March 1955 to Max von Laue, one of the few German physicists with whom he retained a lifelong friendship, he explained:

My action concerning the atomic bomb and Roosevelt consisted merely in the fact that, because of the danger that Hitler might be the first to have the bomb, I signed a letter to the President which had been drafted by Szilard. Had I known that that fear was not justified, I, no more than Szilard, would have participated in opening this Pandora's box. For my distrust of governments was not limited to Germany.

Unfortunately, I had no share in the warning made against using the bomb against Japan. Credit for this must go to James Franck. If they had only listened to him!

The use of the bomb against Japanese civilians was especially painful to Einstein, because he had formed very strong friendships and a special fondness for the people during his visit to Japan in 1922. Not only was there not a single racist bone in his body, but Einstein never held the Japanese people responsible for the war in the sense that he held the German people responsible. Thus, in an uncharacteristically harsh response to an appeal for a "soft peace" from his old friend and fellow refugee James Franck in December 1945, he wrote:

I remember too well the campaign of tears staged by the Germans after the First World War to be fooled by its repetition. The Germans slaughtered several millions of civilians according to a well-thought-out-plan. If they had murdered you too, some crocodile tears would undoubtedly have been shed. The few decent people who are among them do not change the picture as a whole. I have gauged from several letters received from over there, as well as from the information supplied by some reliable persons, that the Germans do not feel one iota of guilt or sorrow. . . . Dear Franck, do not involve yourself in this dirty mess! They will first misuse your kindness and then they will ridicule you for being a fool. But if I am unable to persuade you to refrain, I, for one, will certainly not get mixed up in this affair. Should the opportunity present itself, I shall publicly oppose the appeal.

Nevertheless, he certainly would have opposed the bomb's use against Germany had it been ready in time, as attested in a letter to a Japanese correspondent written on 23 June 1953:

I am a *dedicated* [entschiedener] but not an *absolute* pacifist; this means that I am opposed to the use of force under any circumstances, except when confronted by an enemy who pursues the destruction of life as an *end in itself*. I have always condemned the use of the atomic bomb against Japan. However, I was completely powerless to prevent the fateful decision for which I am as little responsible as you are for the deeds of the Japanese in Korea and China.

I have never said I would have approved the use of the atomic bomb against the Germans, I did believe that we had to avoid the contingency of Germany under Hitler being in *sole* possession of this weapon. This was the real danger at the time.

I am not only opposed to war against Russia but to all war—with the above reservation. . . .

It is far from surprising, therefore, that with World War II over and the intellectual battle lines forming—between those who would have taken advantage of the American nuclear monopoly to establish the dominance of American military influence over all national and international institutions and those who saw the atomic bomb as an opportunity finally to establish international institutions with the intention *and the power* to provide supranational control over future conflict and war—Einstein again plunged enthusiastically into the arena of public affairs. He firmly supported the fledgling atomic scientists' movement, organized into a Federation of Atomic Scientists, and encouraged its voice, *The Bulletin of the Atomic Scientists*. . . .

In support of the various national and international enterprises of the atomic scientists, Einstein agreed in May 1946 to serve as chairman of an Emergency Committee of Atomic Scientists. Its program

was based on an agreed set of principles concerning the dangers of atomic weapons:

These facts are accepted by all scientists:

1. Atomic bombs can now be made cheaply and in large numbers. They will become more destructive.
2. There is no military defense against the atomic bomb and none is to be expected.
3. Other nations can rediscover our secret processes by themselves.
4. Preparedness against atomic war is futile, and if attempted will ruin the structure of our social order.
5. If war breaks out, atomic bombs will be used and they will surely destroy our civilization.
6. There is no solution to this problem except international control of atomic energy and, ultimately, the elimination of war.

The program of the committee is to see that these truths become known to the public. The democratic determination of this nation's policy on atomic energy must ultimately rest on the understanding of its citizens.

The immediate objective was to raise a fund of \$1,000,000 in support of the various educational activities of the atomic scientists aimed at civilian national and international control of future nuclear energy activities. However, although the committee had a certain amount of success in raising money, as time passed it became increasingly clear to Einstein and his fellow committee members that the world was drifting in the wrong direction. In considering the root causes of their failure, Einstein and his colleagues were convinced that the seriousness of the problem demanded more drastic remedies. Their views moved more and more in the direction of "world government" as the only logical solution. . . .

From then on, Einstein became ever more outspoken in his insistence that nothing short of an effective supranational authority able to exercise unquestioned control over international issues of war and peace was needed to save the world from nuclear disaster. He maintained that such an international authority could and should be established promptly through the United Nations, irrespective of whether all the major world powers were ready immediately to join. . . . Although this view was openly and pointedly attacked by Soviet officials, as well as by some Soviet scientists, as playing into the hands of right-wing, anti-Soviet forces, Einstein stood his ground and steadfastly maintained until the end of his life his adherence to the "world government" approach as the only means of saving humankind from the disastrous consequences of the uninhibited national exploitation of inevitable technological progress. . . .

But eternal optimist that he was, Einstein could never give up hope. Thus, in the spring of 1955 he and Bertrand Russell, with typical youthful enthusiasm, launched a project aimed at starting a worldwide movement among scientists to reverse the Cold War trend toward nuclear war. The credo of this movement was the Russell-Einstein Manifesto signed by Einstein on 11 April 1955, exactly one week before his death. The text of this manifesto serves well as a summing up of Einstein's view of the state of the world and of the responsibilities of scientists as world citizens:

In the tragic situation which confronts humanity, we feel that scientists should assemble in conference to appraise the perils that have arisen as a result of the development of weapons of mass destruction. . . .

We are speaking on this occasion, not as members of this or that nation, continent or creed, but as human beings, members of the species man, whose continued existence is in doubt. The world is full of conflicts; and, overshadowing all minor conflicts, the titanic struggle between Communism and anti-Communism.

Almost everybody who is politically conscious has strong feelings about one or more of these issues; but we want you, if you can, to set aside such feelings and consider yourselves only as members of a biological species which has had a remarkable history, and whose disappearance none of us can desire.

We shall try to say no single word which should appeal to one group rather than to another. All, equally, are in peril, and, if the peril is understood, there is hope that they may collectively avert it. . . .

The general public, and even many men in positions of authority, have not realized what would be involved in a war with nuclear bombs. The general public still thinks in terms of the obliteration of cities. It is understood that the new bombs are more powerful than the old, and that, while one A-bomb could obliterate Hiroshima, one H-bomb could obliterate the largest cities, such as London, New York and Moscow.

No doubt in an H-bomb war great cities would be obliterated. But this is one of the minor disasters that would have to be faced. If everybody in London, New York and Moscow were exterminated, the world might, in the course of a few centuries, recover from the blow. But we now know, especially since the Bikini test, that nuclear bombs can gradually spread destruction over a very much wider area than had been supposed.

It is stated on very good authority that a bomb can now be manufactured which will be 2,500 times as powerful as that which destroyed Hiroshima.

Such a bomb, if exploded near the ground or under water, sends radioactive particles into the upper air. They sink gradually and reach the surface of the earth in the form of a deadly dust or rain. It was this dust which infected the Japanese fishermen and their catch of fish.

No one knows how widely such lethal radioactive particles might be diffused, but the best authorities are unanimous in saying that a war with H-bombs might quite possibly put an end to the human race. It is feared that if many H-bombs are used there will be universal death—sudden only for a minority, but for the majority a slow torture of disease and disintegration.

Many warnings have been uttered by eminent men of science and by authorities in military strategy. None of them will say that the worst results are certain. What they do say is that these results are possible, and no one can be sure that they will not be realized. We have not yet found that the views of experts depend in any degree upon their politics or prejudices. They depend only, so far as our researches have revealed, upon the extent of the particular expert's knowledge. We have found that the men who know most are the most gloomy.

Here, then, is the problem which we present to you, stark and dreadful and inescapable: Shall we put an end to the human race; or shall mankind renounce war? People will not face this alternative because it is so difficult to abolish war.

The abolition of war will demand distasteful limitations of national sovereignty. But what perhaps impedes understanding of the situation more than anything else is that the term *mankind* feels vague and abstract. People scarcely realize in imagination that the danger is to themselves and their children and their grandchildren, and not only to a dimly apprehended humanity. They can scarcely bring themselves to grasp that they, individually, and those whom they love are in imminent danger of perishing agonizingly. And so they hope that perhaps war may be allowed to continue provided modern weapons are prohibited.

This hope is illusory. Whatever agreements not to use the H-bombs had been reached in time of peace, they would no longer be considered binding in time of war, and both sides would set to work to manufacture H-bombs as soon as war broke out, for, if one side manufactured the bombs and the other did not, the side that manufactured them would inevitably be victorious.

Although an agreement to renounce nuclear weapons as part of a general reduction of armaments would not afford an ultimate solution, it would serve certain important purposes.

First: Any agreement between East and West is to the good in so far as it tends to diminish tension. Second: The abolition of thermonuclear weapons, if each side believed that the other had carried it out sincerely, would lessen the fear of a sudden attack in the style of Pearl Harbor, which at present keeps both sides in a state of nervous apprehension. We should, therefore, welcome such an agreement, though only as a first step.

Most of us are not neutral in feeling, but, as human beings, we have to remember that, if the issues between East and West are to be decided in any manner that can give any possible satisfaction to anybody,

whether Communist or anti-Communist, whether Asian or European or American, whether white or black, then these issues must not be decided by war. We should wish this to be understood, both in the East and in the West.

There lies before us, if we choose, continual progress in happiness, knowledge and wisdom. Shall we, instead, choose death, because we cannot forget our quarrels? We appeal, as human beings, to human beings: Remember your humanity and forget the rest. If you can do so, the way lies open to a new paradise; if you cannot, there lies before you the risk of universal death.

Questions for Review and Study

1. How was the scientific community—including Einstein—responsible for the creation of the Atomic Age?
2. Was Einstein's preoccupation with world government in his last years an implicit admission of guilt in creating the atomic bomb? Discuss.
3. In light of events since World War II, was the world government proposed by Einstein a realistic plan?
4. To what extent, in your opinion, was Einstein instrumental in beginning the actual work on the atomic bomb?
5. What elements of Einstein's research were instrumental in creating the atomic bomb?

Questions for Comparison

1. Discuss Einstein and Voltaire as embodiments of the Enlightenment spirit. In what sense did Einstein take the path opened two centuries earlier by men like Voltaire? Whose confidence in humankind seems to have been more robust: was the Enlightenment's original faith in human reason still evident in Einstein? Do the different moods of the two thinkers seem to have resulted from different ideas, different temperaments, or different historical circumstances? What did these men regard as the most urgent problems of their respective times? Did the two regard the transnational institutions of their day as helpful or destructive?

Suggestions for Further Reading

Einstein's own statements about the atomic bomb and scientific responsibility were as brief and often cryptic as were his public statements on other subjects. His most substantial comment is the interview with Raymond Graham Swing reproduced in this chapter, but some parallel state-

ments are to be found in his *Out of My Later Years*, especially the section "Science and Life." These as well as nearly all his other related statements are reprinted in *Einstein on Peace*, edited by Otto Nathan and Heinz Norden. Some of his concern comes through in *The Born—Einstein Letters*, translated by Irene Born, but this book is much more revealing of Born's anguish. The same sentiment is expressed throughout the world community of nuclear physicists, as Werner Heisenberg's *Physics and Beyond* demonstrates and as does Otto Hahn's *My Life*. The same sorts of views are expressed in the United States by J. Robert Oppenheimer in *The Flying Trapeze*, especially the third crisis dealing with the atomic bomb and the moral responsibility of scientists, and in *The Open Mind*.

Most of the books about Einstein deal with his scientific and technical work: *The Universe and Dr. Einstein*, by Lincoln Barnett, or Jeremy Bernstein's *Einstein*, for example. The best of these scientific biographies is 'Subtle Is the Lord,' by Abraham Pais. See also Pais's *Einstein Lived Here*; Michael White and John Gribbin's *Einstein*; and David Cassidy's *Einstein and Our World. Some Strangeness in the Proportion*, edited by Harry Woolf, is entirely devoted to the evaluation of Einstein's work as a scientist and scientific theorist.

The best and most comprehensive biography, by Ronald W. Clark, does focus on the political and social implications of Einstein's work rather than strictly on the work itself. To a somewhat lesser extent, this is the case with Banesh Hoffman's *Albert Einstein*. Antonia Vallentin's *Einstein* is interesting in that it deals more fully than any other book with the intimacies, family relations, and day-to-day affairs of Einstein. This aspect of his life is also revealed in *Albert Einstein, the Human Side*, edited by Helen Dukas and Banesh Hoffman. Jamie Sayen's book *Einstein in America* is a somewhat too adulatory treatment of its subject. See also *The Private Lives of Albert Einstein*, by Roger Highfield and Paul Carter; Denis Brian's *Einstein*; and Clarice Swisher's *Albert Einstein*.

Lansing Lamont's *Day of Trinity* is a fascinating account of the making and dropping of the atomic bomb. The implications of that employment are dealt with in several important books: *The Atom Bomb and the End of the War in the Pacific*, by Herbert Feis; *A World Destroyed*, by Martin J. Sherwin; *Atomic Diplomacy*, by Gar Alperovitz; and in *The Wizards of Armageddon*, a brilliant and controversial work by Fred Kaplan, a leading defense analyst. Some of these issues and others are conveniently presented in *The Atomic Bomb*, a book of readings edited by Barton J. Bernstein. (Titles with an asterisk are out of print.)

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